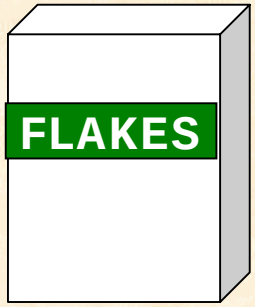
Just What Exactly are "Reference Conditions" ?

What Are "REFERENCE CONDITIONS" ?

Generic-brand RCs:



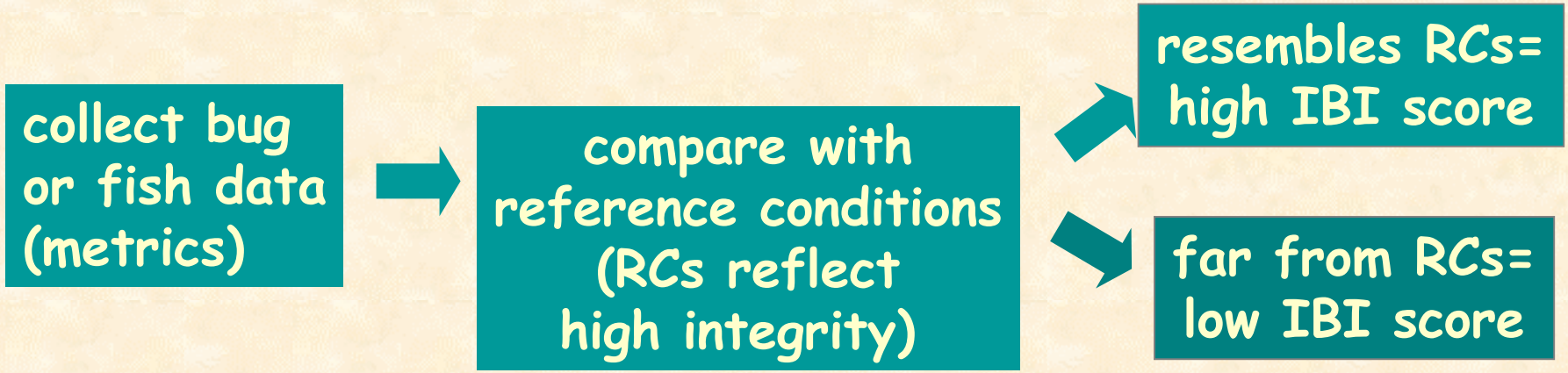
Target values (of chemical, physical, or biological parameters) that reflect the desired results of resource management, regulation, or conservation. Useful as "benchmarks" or "endpoints".

Name-brand RCs: ????

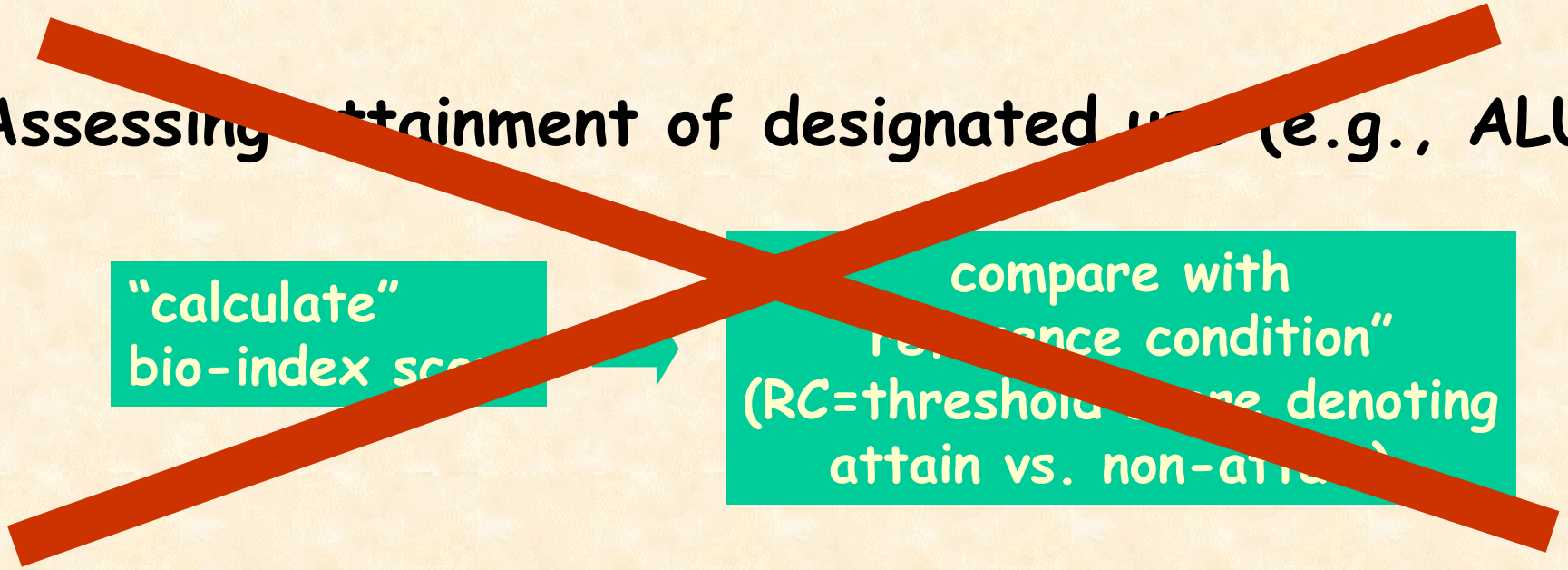
(no single, consistently clear definition in current literature)

"REFERENCE CONDITIONS" are benchmarks for...

1. Measuring biological condition (e.g., IBI)



2. Assessing attainment of designated use (e.g., ALU)



"Reference Conditions" means different things...

"...must represent important aspects of 'natural' or pre-Colombian conditions." (Hughes 1995)

"Despite considerable difficulty in defining and quantifying 'natural', our charge...is to restore and maintain the natural structure and function of aquatic ecosystems." (Hughes 1995)

BUT...

"Given the difficulty of empirically determining what conditions would be like in the absence of humans... we are forced to use minimal disturbance as a reference condition." (Hughes 1995)

"Reference Conditions" means different things...

"...the reference condition should describe the site as one would expect to find it under natural or minimally impaired conditions." (Hughes 1995)

BUT...

"natural" ≠ "minimally impaired"

[**minimal** *adj.* related to or being a minimum: **least**; smallest in amount or degree]

Should my RCs reflect... a) highly natural or

b) least impaired ?

(i.e.,relative only to that which is readily observable)

CONFUSED YET?

Does "reference condition" mean...

... natural ?

"In no instance should any notably degraded condition be accepted as the reference for [bio-]criteria development."
(USEPA biological-criteria guidance for streams --1996)

or

... least disturbed ?

"Because absolutely pristine habitats do not exist... a critical element in establishing reference conditions is deciding how to determine that a site is only 'minimally impaired'. How much degradation can be allowed?"
(USEPA biological-criteria guidance for streams --1996)

...GETTING ANY CLEARER?

Does "reference condition" mean...

... natural ?

"...the ideal reference condition must represent aspects of naturalness...
...support and maintain a community of organisms having a composition, diversity, and functional organization comparable to that of the natural habitat of the region."

(Barbour et al. 2000; *Hydrobiologia 422/423: 453-464*)

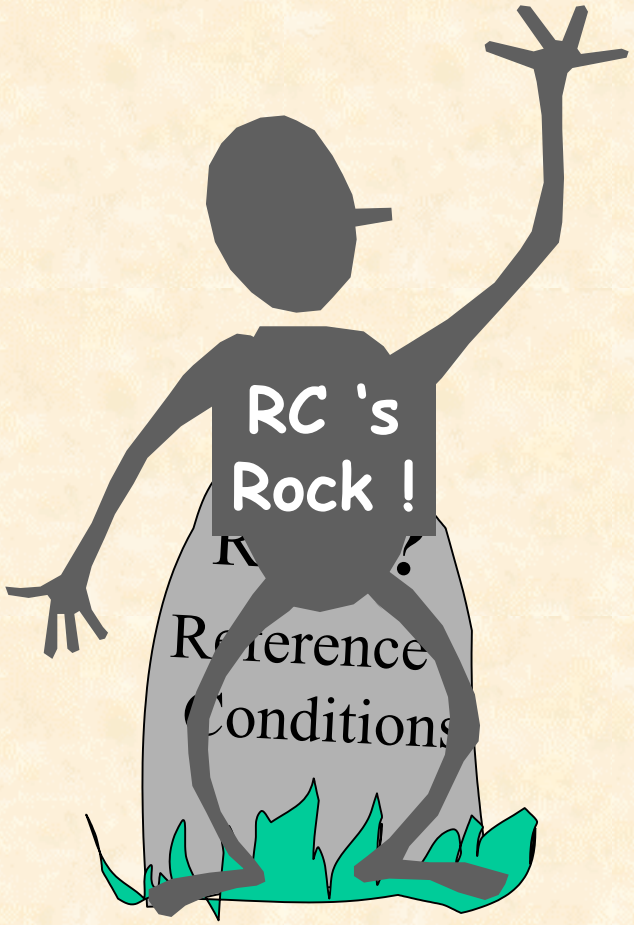
or

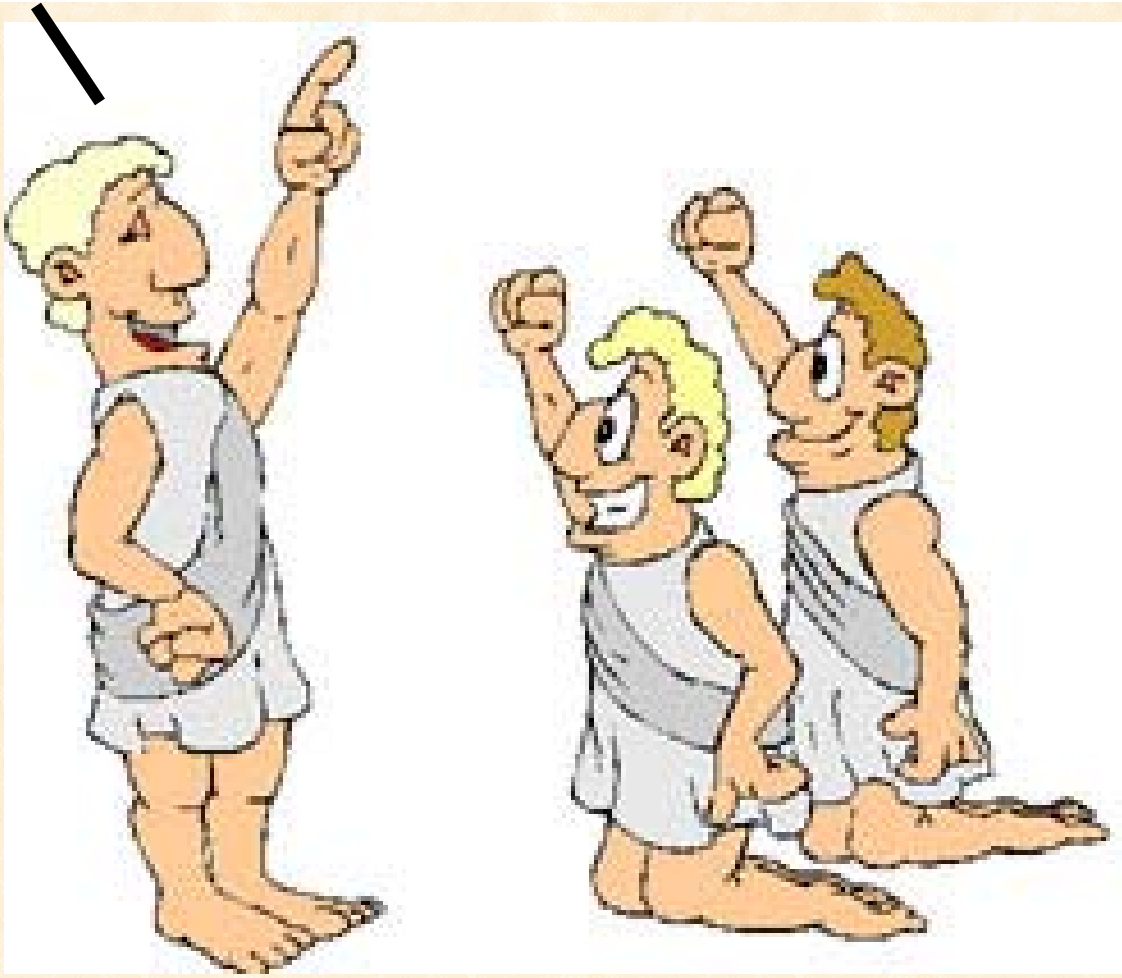
... least disturbed ?

"...reference condition(s) is based on identification of minimally disturbed sites that represent the best physical, chemical, and biological conditions attainable."

(Barbour et al. 2000; *Hydrobiologia 422/423: 453-464*)

Friends, Romans, and you in the funny bath-towel thing,
lend me your ears.
I come to bury Caesar, not to praise him...





HOW RCs DEFINE BIOLOGICAL INDEXES

LEAST = Ref.Cond.

MOST

OBSERVABLE GRADIENT of HUMAN IMPACTS

OUCH !

MAX. INDEX SCORE

MIN. INDEX SCORE

? ?

NATURALNESS, INTEGRITY, ATTAINMENT

ADRIFT IN A SEA OF "NATURALNESS"...

(...um...relatively speaking, that is)

RCs IN PRACTICE

Resource decisions improved by defining RCs (i.e., benchmarks, endpoints) empirically & quantitatively,

therefore...

...most beneficial to define "naturalness" on relative scale of observable, measurable disturbance

How disturbed is "least disturbed" ?

NATURAL or LEAST-DISTURBED ?

(NOT always the same thing)

By necessity, RCs are relative conditions--
(may not reflect high integrity)

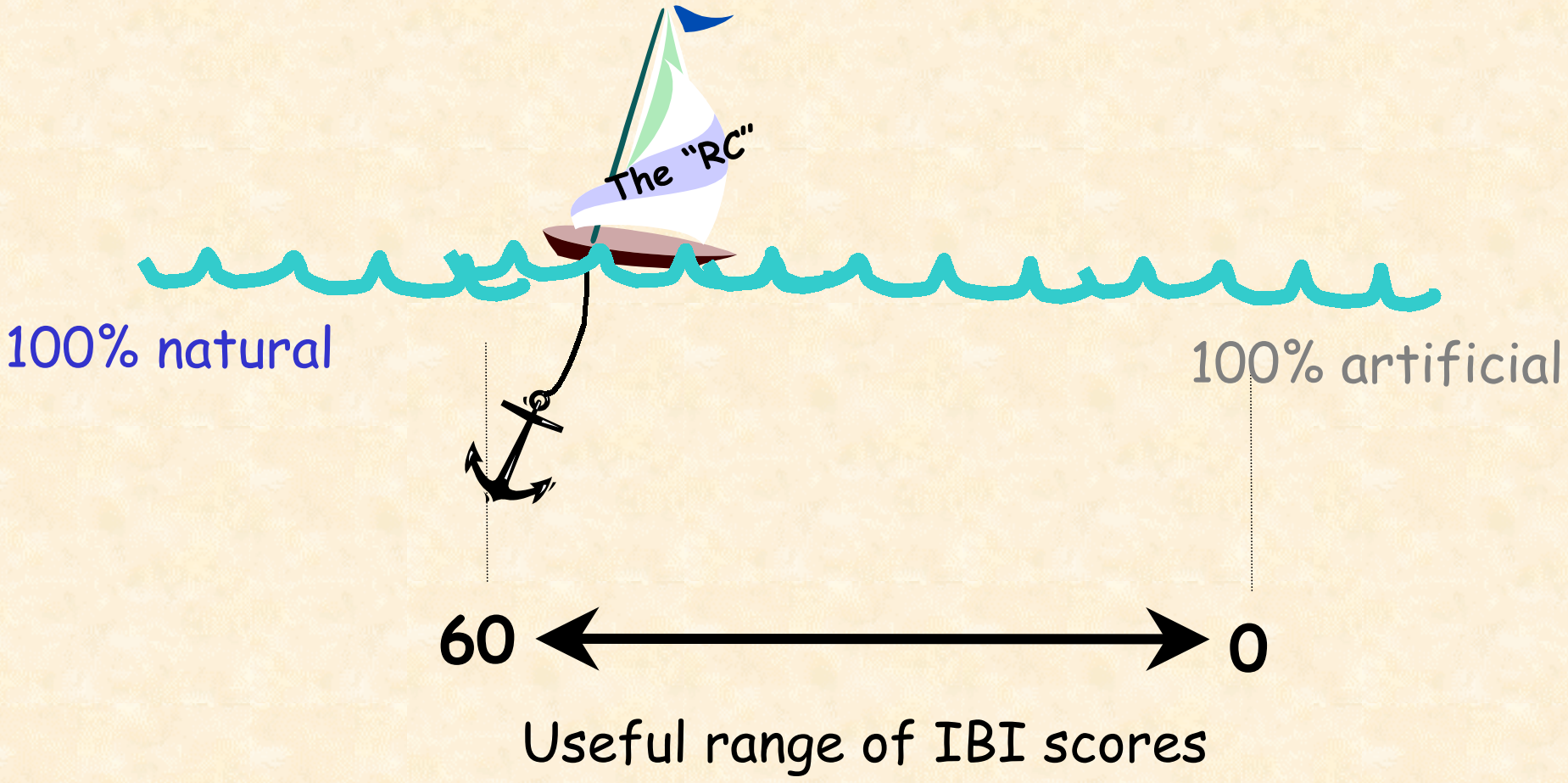
Therefore...

...by design, biological idexes based on RCs are merely relative measures of integrity

How much integrity does a high IBI score represent ?

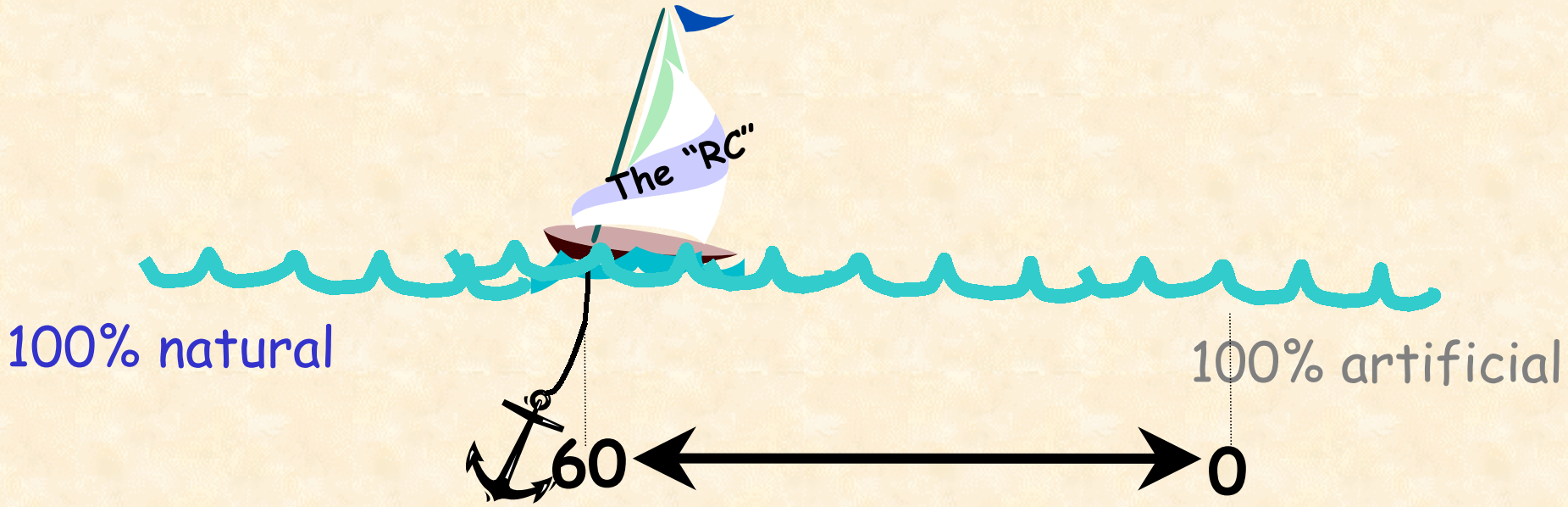
BIOLOGICAL INDEXES ADRIFT

Where Do My IBI Scores Fit ?



MARRYING "THE EMPIRICAL" WITH..."THE CONCEPTUAL"

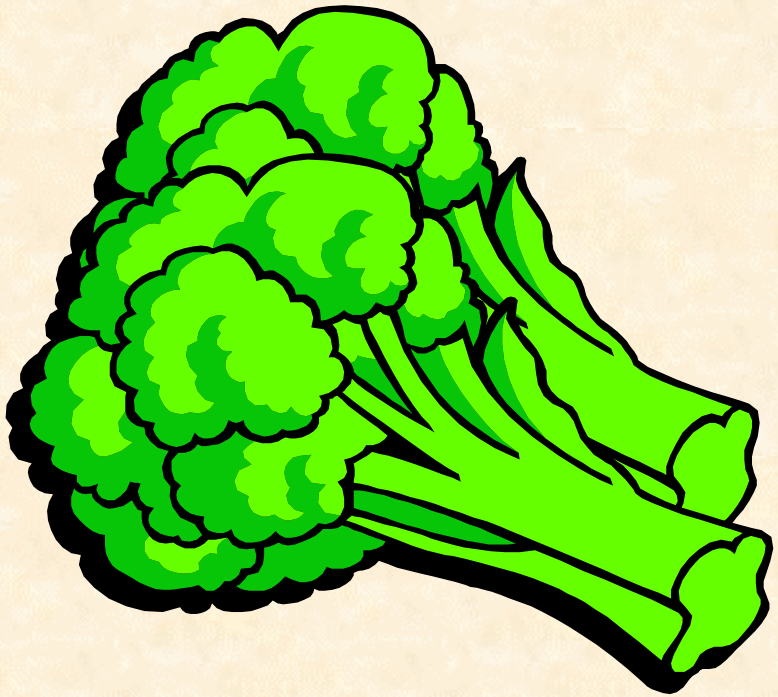
HOW DO WE DEFINE RCs & INTERPRET BIOLOGICAL INDEXES BASED ON RCs ?



It's all about VALUES !!

GOOD FOR US

BAD FOR US



" Yummy !! "

" Yuck ! "

GOOD

BAD

"It rocks !! "

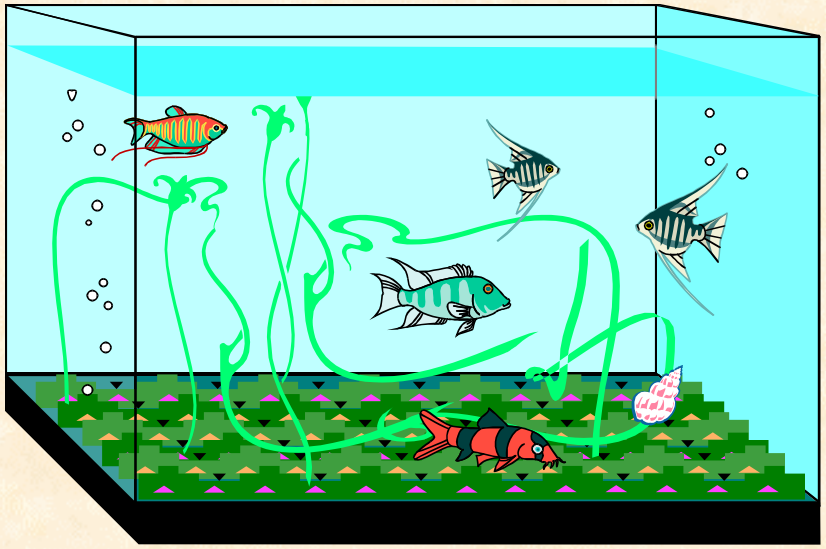
"Ear candy !! "

"Worse than flossing !! "

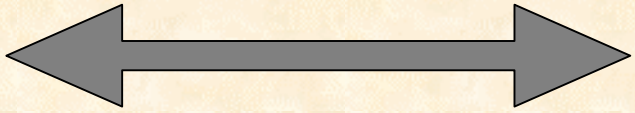
"Please dispose of properly !! "

GOOD ⟷ (really) **BAD**

" Now that's more like it. "



"Not quite what
we had in mind. "

GOOD  **BAD**

SCALES OF RESOURCE CONDITION & WORTH

Societal Value

Good for us — okay — so-so — Bad for us

Naturalness/ Integrity

100% natural — mixed — 100% artificial

CWA Goals

fishable & swimmable — not

Attainability

can't do — can do — (can't do)

Aquatic Life Use

Fully Attained — Partially... — Not..

Useful Range of Illinois IBIs

60 — 0

Disturbance:

-chemical

-physical

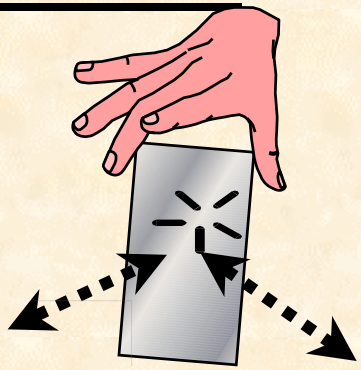
(biological)

a little — more — lots

What Are "REFERENCE CONDITIONS" ?

1. Measurable conditions

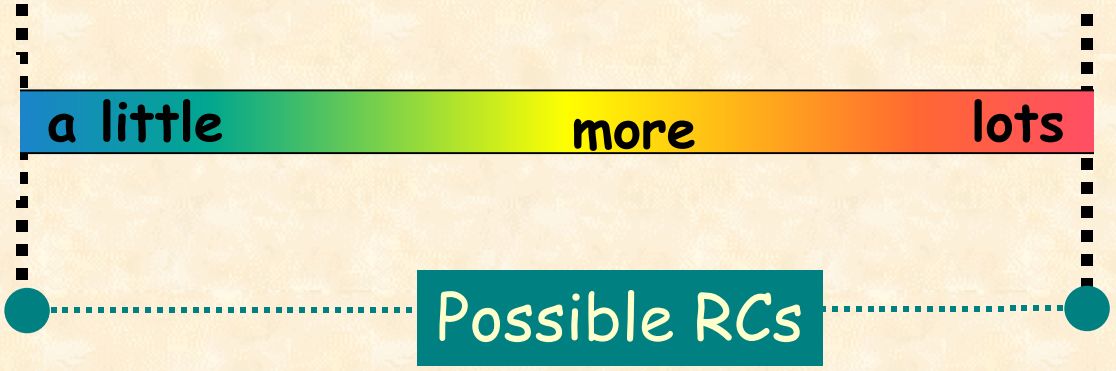
Chemical,
Physical, &
Biological parameters



FIVE KEY FACTORS

flow regime
habitat structure
water quality
energy source
biological interactions

Disturbance:
-chemical
-physical
(biological)



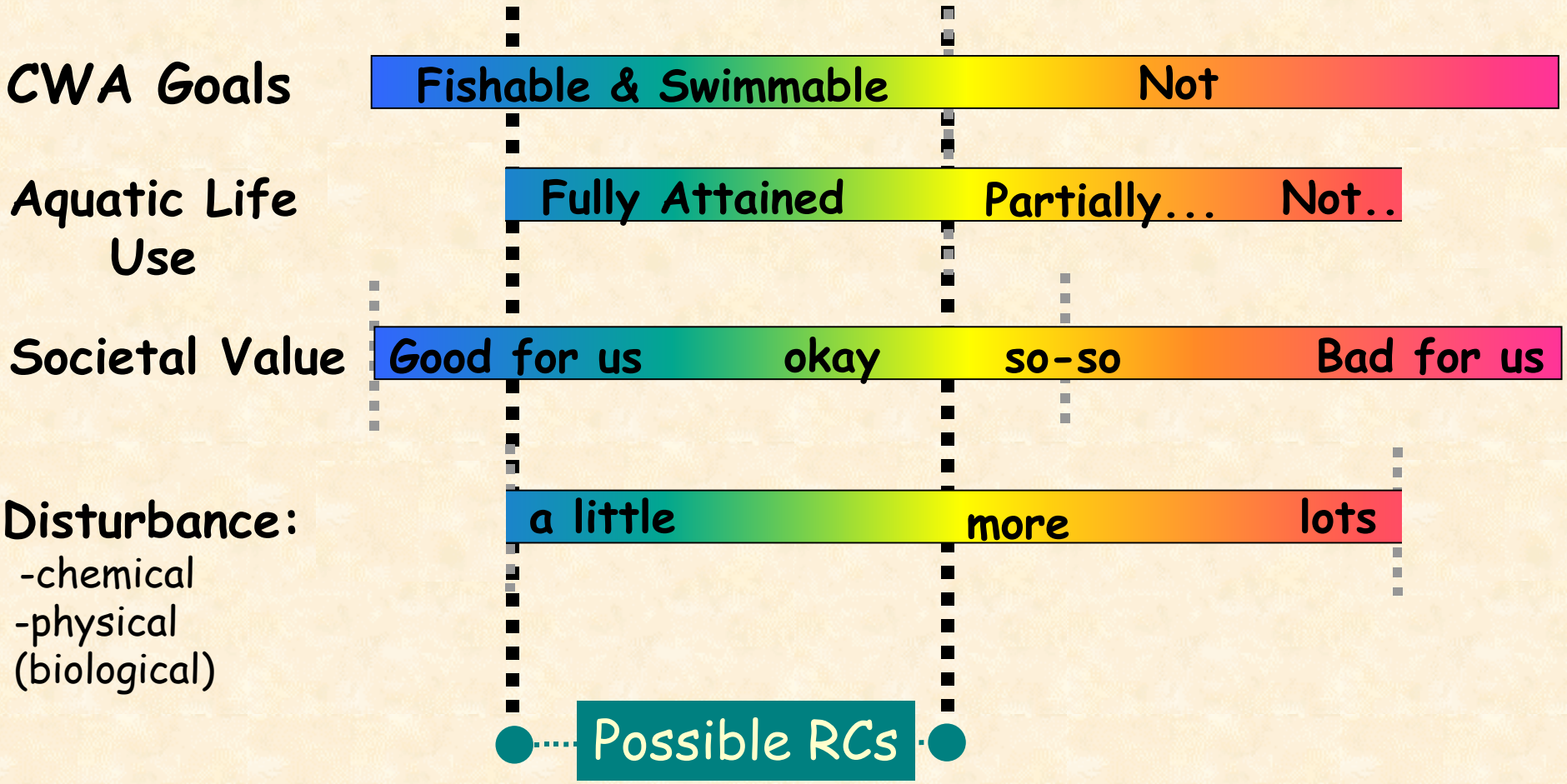
What Are "REFERENCE CONDITIONS" ?

1. Measurable conditions
2. **Desirable conditions**

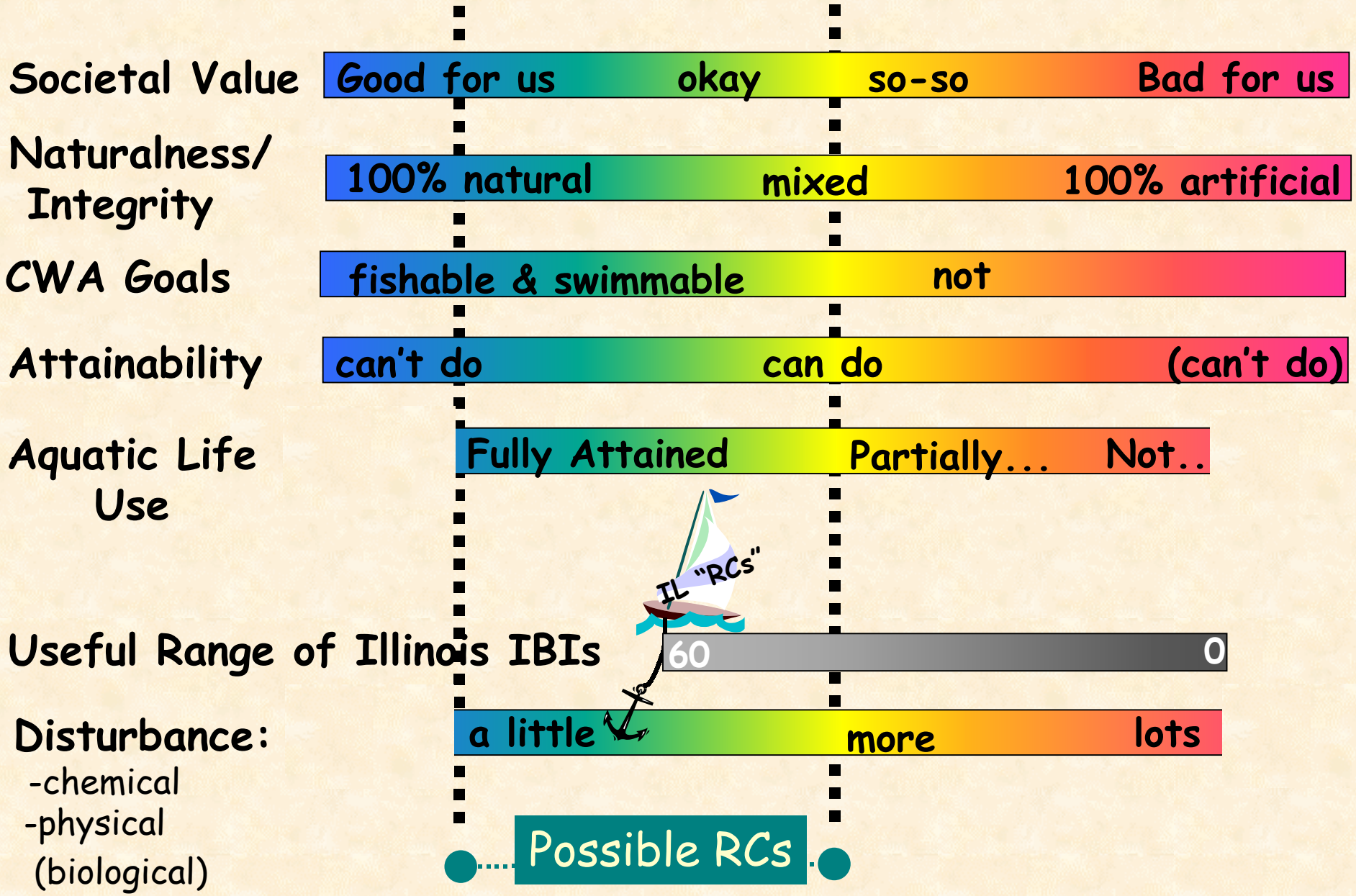
What Are "REFERENCE CONDITIONS" ?

1. Measurable conditions
2. Desirable conditions

3. **Relevant conditions** (e.g., benchmarks, thresholds)



SCALES OF RESOURCE CONDITION & WORTH



Reference Conditions are:

1. Measurable,
   but not required to be attainable
   for all designated uses

2. Desirable,
   but not required to be highly natural

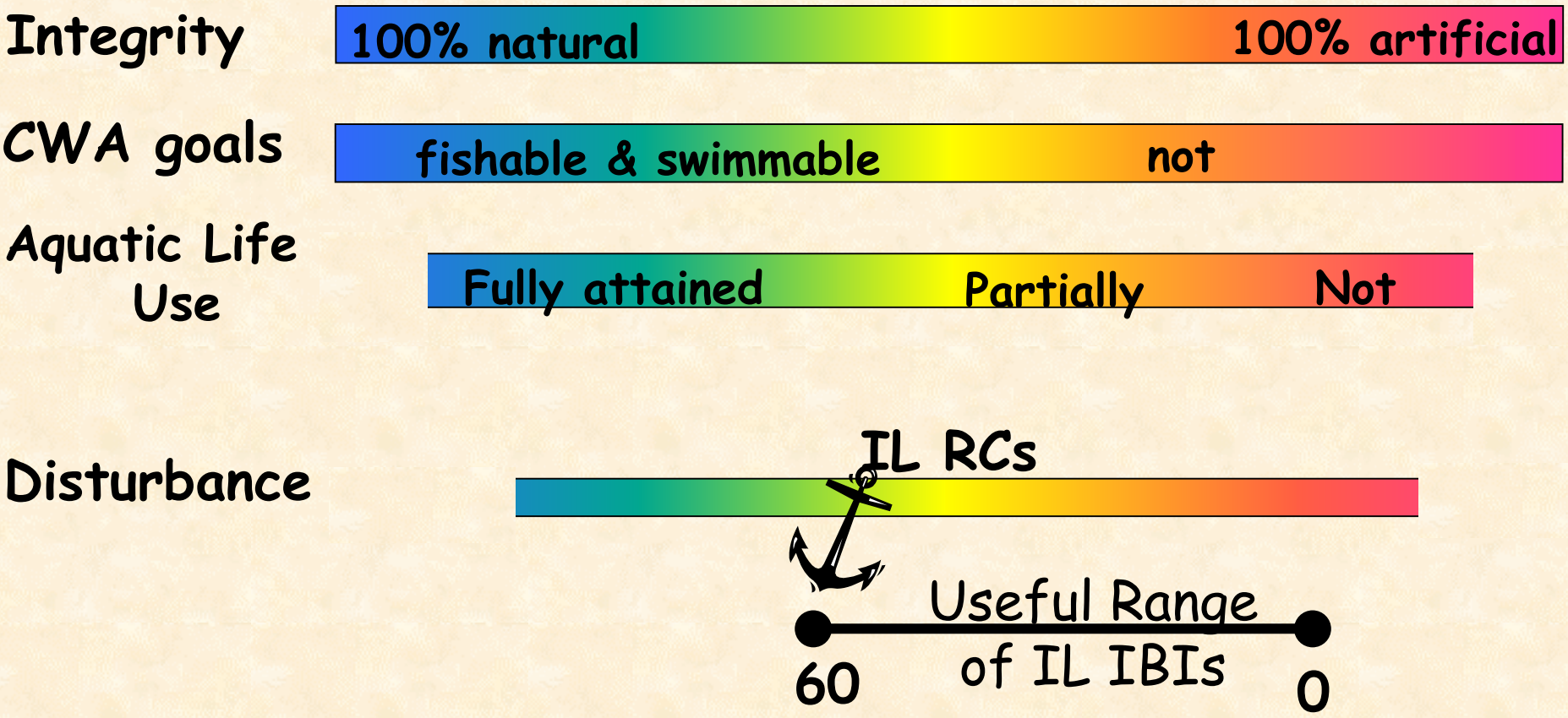
3. Explicitly relevant,

   e.g.,

   - benchmarks for developing IBIs ?
   - thresholds for assessing use attainment ?
   - resource-management endpoints ?

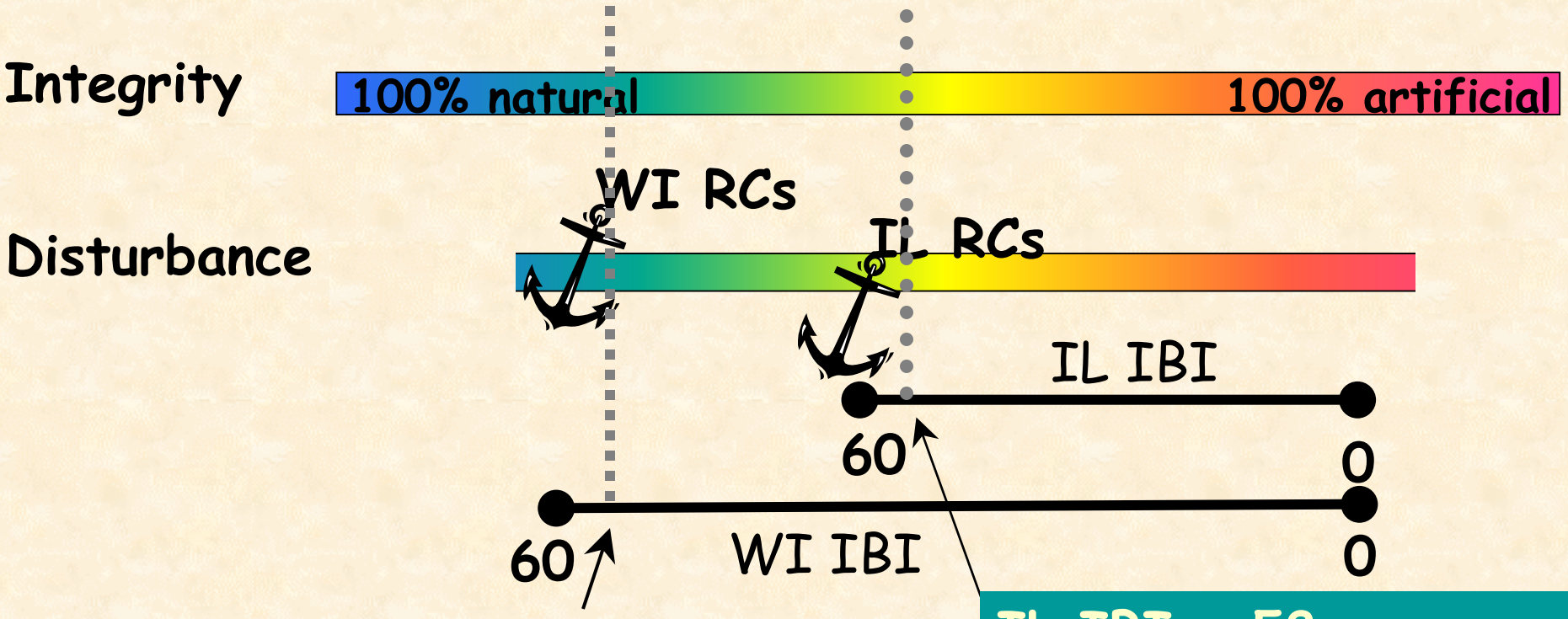
Usefulness of RCs Depends On...

...where RCs fit along scales of resource condition & worth



Interpretability of Biol. Indexes Based on RCs Depends On...

...where RCs fit along
scales of resource condition & worth



WI IBI = 58
"Excellent" integrity

IL IBI = 58
"Excellent" integrity ?

"Imperfect knowledge does not justify rejection of naturalness as a conservation imperative."

Angermeier (2000)

...HOW 'BOUT NOW?

Does "reference condition" mean...

... natural ?

"Reference conditions are a representation of the biotic potential for lakes in the absence of human activity or pollution..."

(USEPA biological-criteria guidance for lakes & reservoirs--1998)

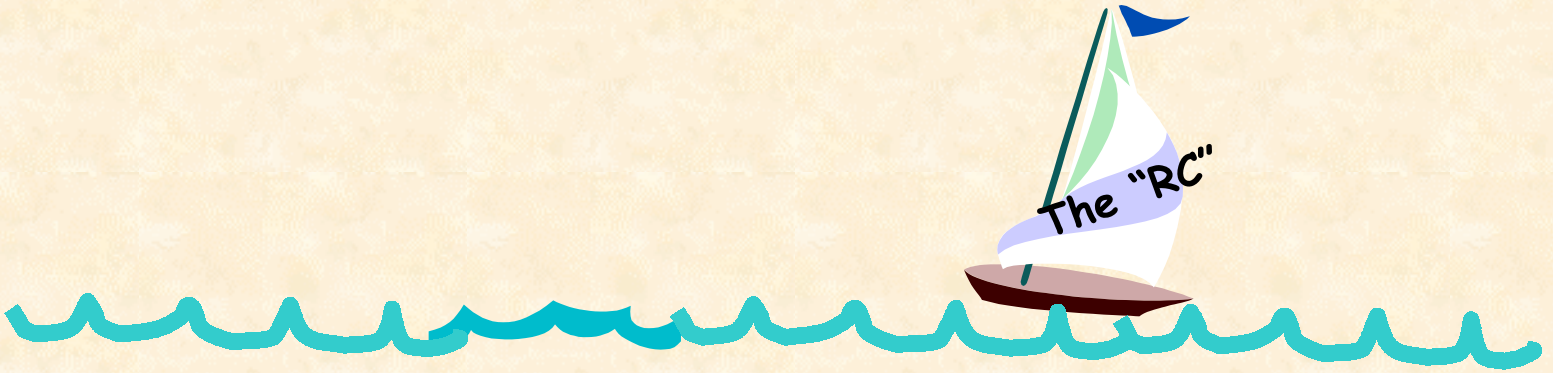
or

... least disturbed ?

"Since nearly all lakes are affected by human activities to some degree, the lakes need not be pristine or unimpacted, but the level of impact must be minimal relative to lakes in the region."

(USEPA biological criteria guidance for lakes & reservoirs --1998)

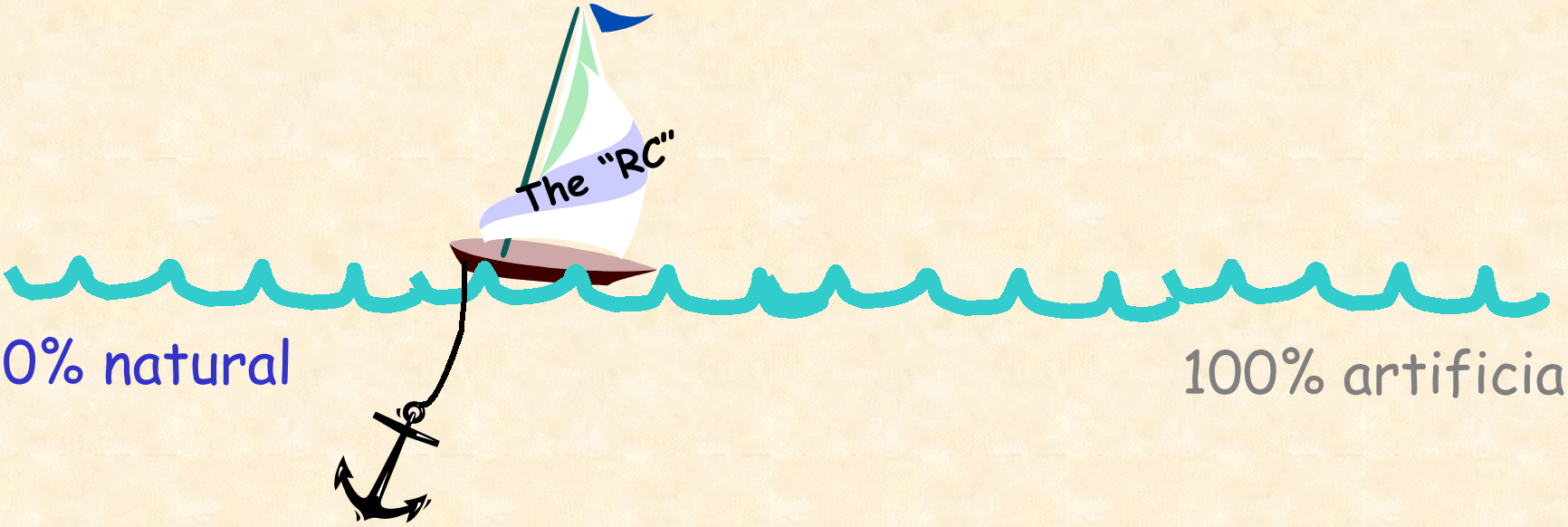
REFERENCE CONDITIONS ADRIFT



100% natural

100% artificial

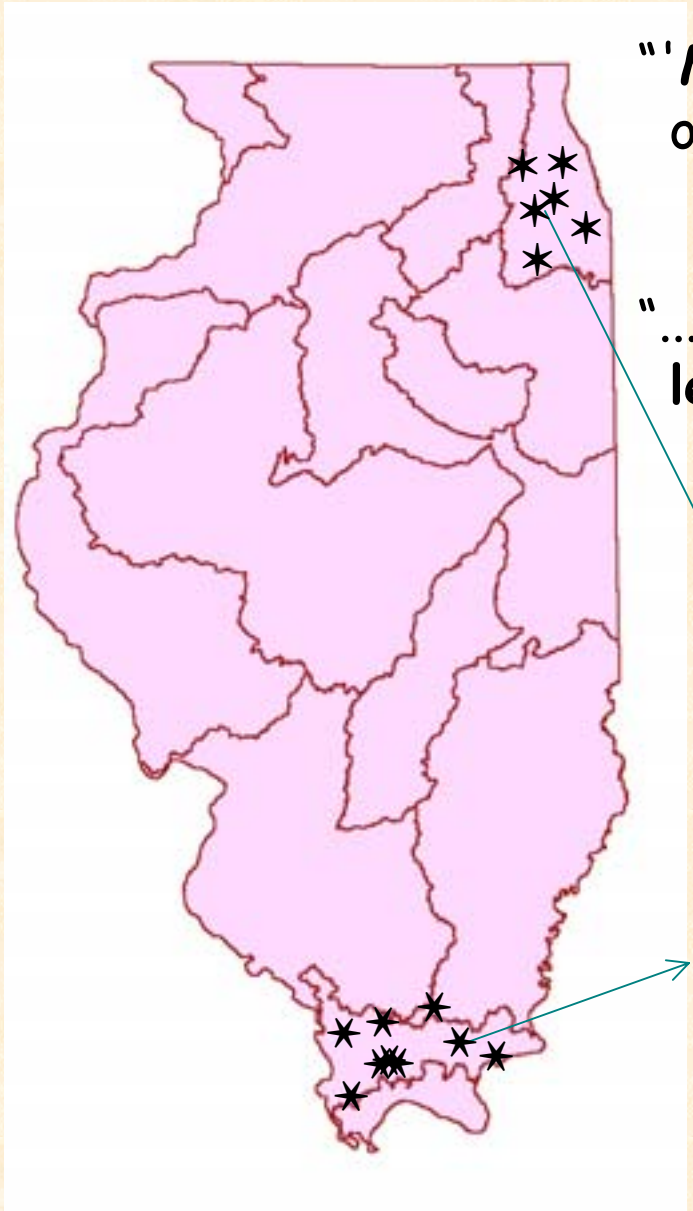
Where Do My RCs Fit ?



100% natural

100% artificial

RCs "ADRIFT" in SPACE: Be Careful w/"Regional" RCs



"'**Minimally impaired**' is therefore interpreted on a **relative, sliding** scale in each subecoregion."
(USEPA 1996)

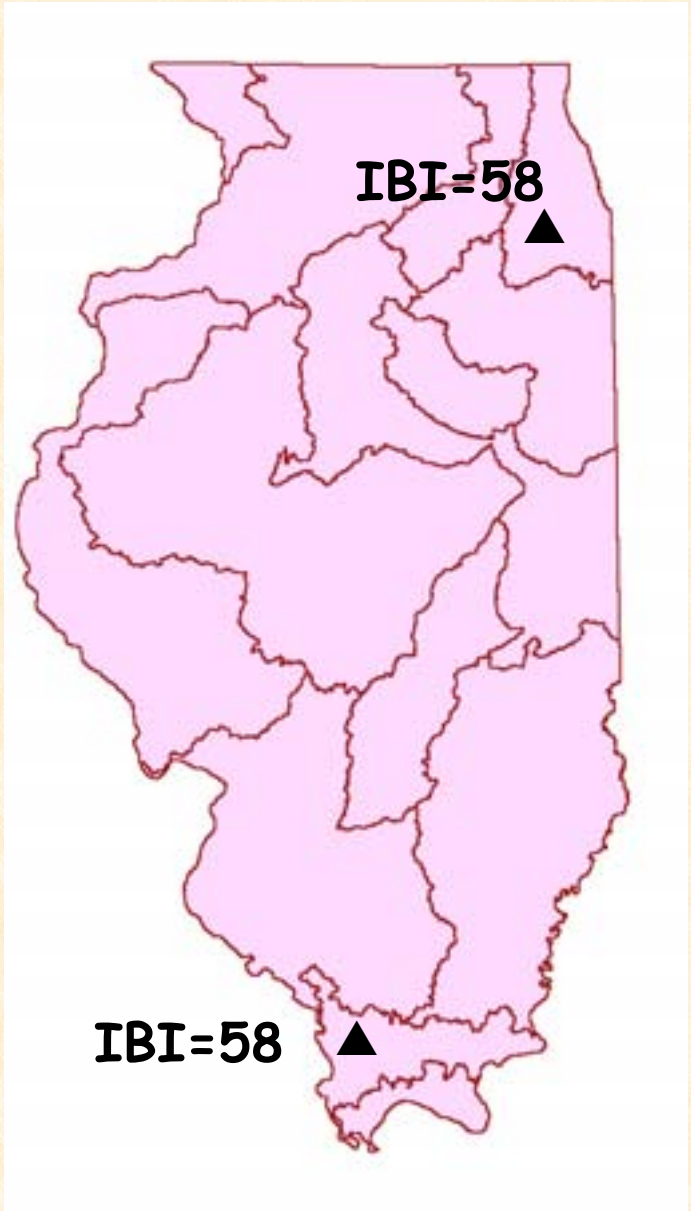
"...candidate reference lakes are those that are **least impacted** relative to the **regional norm**."
(USEPA 1998)

Region 3:
least-disturbed = urban, populated,
(ref. condition) low naturalness

Region 12:
least-disturbed = forested, low pop.,
(ref. condition) higher naturalness

WHEN AN APPLE IS NOT AN APPLE...

(i.e., "58" ≠ "58")



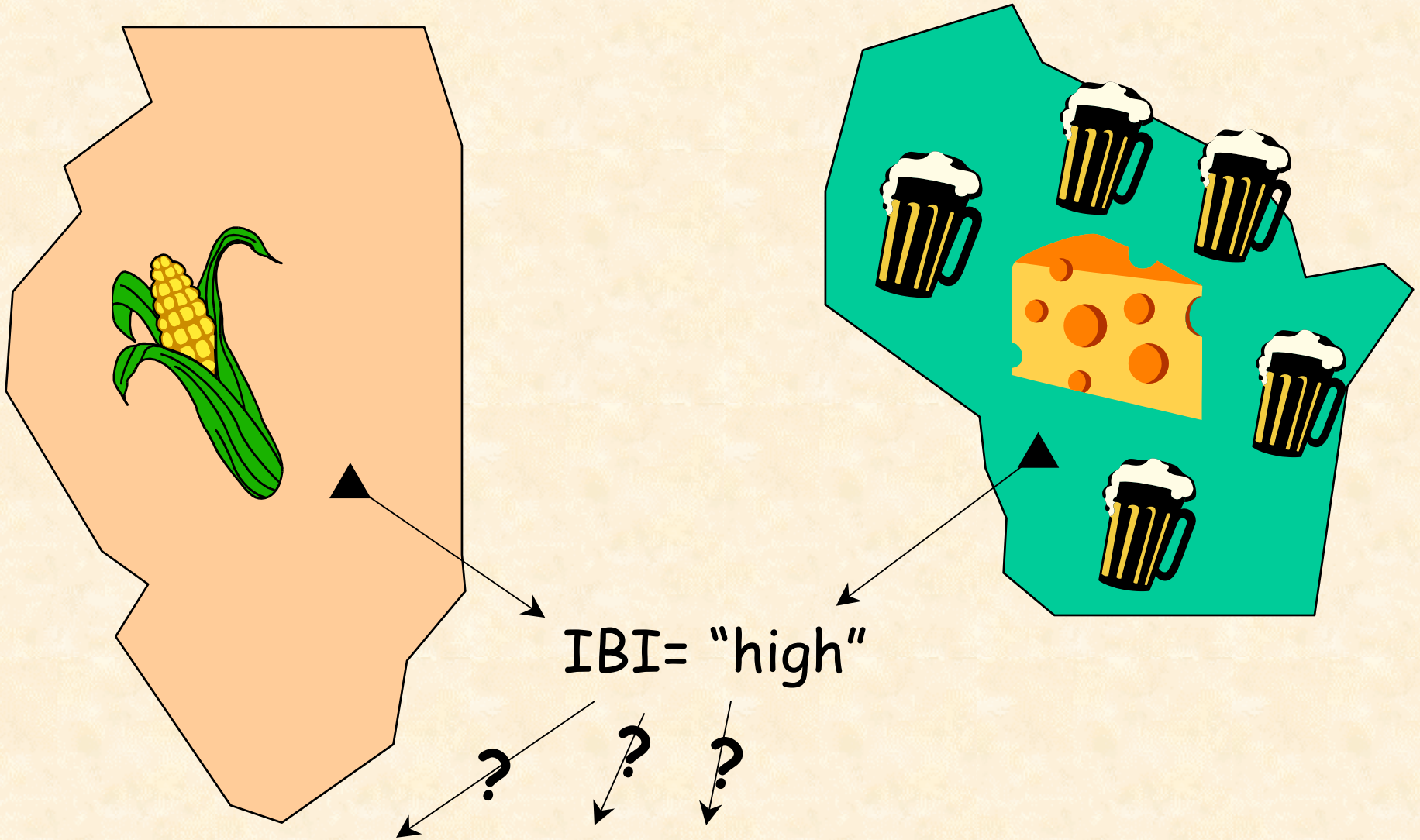
In Region 2,

high IBI (i.e., 50-60) means site is similar to "reference conditions" = urban, populated, low naturalness

In Region 12,

high IBI (i.e., 50-60) means site is similar to "reference conditions" = forested, low pop., higher naturalness

WHAT DOES AN IBI SCORE REALLY MEAN ?



SCALE OF RESOURCE CONDITION & WORTH